ESTONIAN UNIVERSITY OF LIFE SCIENCES

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THE GROWTH OF FINNHORSE AND STANDARDBRED FOALS IN LOOSE HOUSING SYSTEM IN FINLAND

SOOME HOBUSE JA AMEERIKA TRAAVLI VARSSADE KASVUIIVE SOOME VABAPIDAMISTALLIDES

Final Thesis

Curriculum in Veterinary Medicine

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ABSTRACT

Estonian University of Life Sciences Kreutzwaldi 1, 51014, Tartu Estonia		Abstract of Final Thesis	
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The aim of this work is to observe the growth of weanling horses in Finnish loose-housing stables. The study observed the growth of 37 weanlings in 8 Finnish loose-housing stables during early winter. Horses were weighed and height at withers was recorded. A clinical health exam was completed once in the study period. The BCS was used to evaluate the energy and feeding status. The health of the weanling horses was recorded during all the weighing visits by interviews. The parasitic burden was measured by fecal parasitic egg count. A fecal sample was obtained from 34 foals. Four of these had EPG values above 250. Eggs of *Strongylus* spp and *Parascaris equorum* were detected.

The Standardbred weanlings were, in general, smaller than Finnhorse weanlings during the study period. The average daily gain followed the same trend.

The study shows that Finnhorses are more suitable for a loose housing system as a foal. Standardbreds, especially the individuals born late in the summer, would benefit from housing indoors in warmer conditions. The Standardbred foals in loose housing system have a risk of being too low in weight, harming the general health and development.

Loose housing as a solution for keeping foals has many benefits. The positive effects to the behavior, musculoskeletal and respiratory system are lifelong. It is shown that loose housing horses in groups presents no more risk of injury than housing in single boxes.

Keywords: weanling, development, stable, housing

LÜHIKOKKUVÕTE

Eesti Maaülikool Kreutzwaldi 1, 51014, Tartu		Lõputöö lühikokkuvõte	
Autor: Piia Anneli Vaakanainen		Õppekava: Veterinaarmeditsiin	
Pealkiri: *S*oome hobuse ja ameerika traavli varssade kasvuiive soome vabapidamistallides			
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Antud lõputöö eesmärk on hinnata võõrutusjärgsete varssade kasvuiivet Soome vabapidamistallides. Uuringu käigus hinnati talve algusperioodil 37 varsa kasvuiivet kaheksas Soome vabapidamistallis. Hobused kaaluti ning nende turjakõrgused salvestati. Kliiniline ülevaatus viidi läbi ühel korral uuringu jooksul. Energia ja söötmise seisundi hindamiseks kasutati kehamassiindeksit. Varssade tervislik olukord salvestati igal kaalumisvisiidil sooritatud intervjuude käigus. Parasiidikandlust hinnati roojaproovides olevate parasiidimunade hulka analüüsides. Roojaproov saadi 34 varsalt. Nelja puhul oli EPG väärtus üle 250. Leiti *Strongylus* spp ja *Parascaris equorum* mune. Uuringu jooksul olid ameerika traavlivarsad üldiselt soome hobuse varssadest väiksemad. Keskmine päevane kasvuiive jälgis sama trendi. Uuringu käigus selgus, et soome hobused sobivad võõrutusjärgselt varssadena paremini vabapidamistallidesse kasvama. Ameerika traavlitel, eriti suve lõpu poole sündinutel, oleks kasulikum elada sisetingimustes, kus on soojem. Ameerika traavlivarssadel, kes kasvavad üles vabapidamistallides, on risk jääda liiga alakaaluliseks, millel võib olla negatiivne mõju üldisele tervisele ja arengule. Vabapidamissüsteemil varssade pidamisel on mitmeid kasutegureid. Positiivne mõju käitumisele, luu-ja lihaskonnale ning hingamiselundkonnale on elukestev. Samuti on näha, et vabapidamine ei suurenda üksikboksis pidamisega võrreldes vigastuste riski.			
Märksõnad: võõrutusjärgne varss, areng, tall, pidamine			

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LIST OF ABBREVIATIONS

BCS	Body condition score
COLT	Male foal
FH	Finnhorse
FILLY	Female foal
G	Grams
KG	Kilograms
SB	Standardbred horse

DEFINITIONS

Finnhorse	A native, cold blood horse breed of Finland
Standardbred	An American, warmblood horse breed
Weanling	A Foal post-weaning till 12 months of age
Yearling	A young horse from 12 to 24 months of age

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INTRODUCTION

Nowadays the best racehorses are worth tens of thousands of euros at the age of one, and even higher at the age of two, so getting them racing and gathering earnings has major financial importance. (Santschi *et al.*, 2017; Avelsföreningen för Svenska Varmblodiga Travhästen, 2020) This also requires the health of the horses to be at highest possible standards throughout the racing career right from the early days of life (Rogers *et al.*, 2012).

King *et al.* (2019) are pointing out also the safety factor. The horse breeders are nowadays giving great value to the fact that foals are calm and well-trained. This kind of well-behaving foals are involved in fewer injuries and are also safer for the people who are handling them.

Many factors influence the value of the yearling, but the two key factors that play a major role, are pedigree and physical appearance. Since pedigree is always well-documented, it has a vital role in determining the animal's value (MacCarthy *et al.*, 1974; Pagan *et al.*, 2006).

Both, Pagan *et al.* (2006) and Jelan *et al.* (1996) while referring to Watkins *et al.* (1991) state that modern horse breeders have the interest to produce quality yearling foals for sales. From the buyers' part, there is a selection pressure for early physical maturity on the foals, since there is a need to begin training and racing career at a relatively young age. The main selection criteria are among others, rapid growth plus large and muscular body type of the foal.

While having animal welfare in mind, a loose housing system is considered to be a more natural way of keeping animals than housing them at least part of the day in single boxes in a stable. In a study by Autio *et al.* (2005), the researchers did verify that the animals were able to perform species-specific behavior patterns like resting, eating, being active, and following the normal daily rhythm of these activities.

In a recent study by Mejdell (2020), there is stated that housing horses of all ages outdoors permanently is gaining popularity in the Nordic countries. In the year 2015 Hartmann *et al.* made a study involving a total of 3,229 horse owners from Sweden, Finland, Denmark, and Norway. In this study, the great majority of respondents (86%) agreed that housing horses in groups does have a beneficial effect on their welfare. Yearlings were the category of horses most often grouped, most of them (74,6%) were kept grouped all the time.

Keeping foals in loose housing stables means they are kept in groups and therefore they are able to interact more. In a study by Søndergaard and Ladewig (2004) they compared single and group-housed foals. The group-housed foal did bite their owners less and also the responses of group-housed horses to training clearly demonstrate the benefits of raising young horses in groups. In the same study they stated that horses kept in social groups were also easier to handle.

Trainers also seem to appreciate the fact if foals are easy to break and train right from the arrival to the training facility. It seems that housing horses in groups, firstly, enables them to fulfill their motivation for social behavior so that they do not have the same need for social interaction as singly housed horses and, secondly, it teaches them to react to another horse or human so that it is easier for the horses to understand the commands and messages from the people that are handling or training them (Søndergaard and Ladewig, 2004).

In their study on 43 foals which were genetically predisposed to develop osteochondrosis, Barneveld and van Weeren (1999) determined that the opportunity to move and this way the intensity of physical exercise are the main determinators of the biomechanical loading of foal's musculoskeletal tissues. Confinement of foals to stables inhibited musculoskeletal development, and brief exercise in addition to confinement or continual paddock exercise resulted in tissue properties that in general made bones more resistant to deformation, especially osteochondral lesions.

Rogers and Dittmer state in their article (2019) that spontaneous locomotor play as a foal might be vital to make sure as optimal as possible bone development. This also creates a need for the modern production systems to provide appropriate possibilities and this way reduce the risk of future musculoskeletal injury later in life.

1. REVIEW OF THE LITERATURE

5.2. Need for fast growth and physical maturity of the foals

In order to give their foals as much time as possible to develop before the start of the training and racing strain to the body and locomotion apparatus, breeders are keen to cover their mares as early in the spring as possible. (Saastamoinen, 1990) Also, the length of the 11-month long gestation period is a reason why a breeding mare should become pregnant relatively soon after the previous foaling in order to foal every year (Katila and Reilas, 2001).

On the other hand, Katila and Reilas list in their study (2001) reasons why breeders should not cover their mares to the first heat after foaling, called foal heat. The most significant arguments are as follows: lowered pregnancy rate of the mare, the tendency to increased pregnancy loss, and the risks of injury to a young foal while transported to the breeding location.

1.1.1. Significance of the month of the birth to the growth rate

Already in 1974 MacCarthy and Mitchell were discussing in their study the situation the breeders of racehorses are facing with a wide range of birth months of the foals. They did divide the age of the horse into three different types.

The first one is the natural chronological age, which dates from its month of birth. The second, more significant is the stage of physiological age, meaning the physical development of the foal at any point in time. The third age is the animal's 'official' age that is used in

official records by registration authorities. This takes no cognizance of the true or physiological age of the animal and is only dated from January 1st of the year of birth. This produces the situation in 2-year-old racing whereby the physiologically older animal is thought to have a competitive advantage (MacCarthy and Mitchell, 1974).

In a Finnish study by Saastamoinen (1990) they found out that the month Finnhorse foal was born had an influence on the growth of the foal. In general, by the end of the summer, young horses born in May tended to be larger than horses born in any other month. Similarly, the foals born in May at the latest seemed to grow faster than foals born later in the spring or summer.

The influence of the month of the birth can be explained by the nutritional quality of the feeds, the nutritional status of the mare and the foal, and also the amount of physical exercise. In Saastamoinen's conclusion of the study (1990) these factors seem to be the limiting ones in the development of the foal in the Nordic climate conditions. As another limiting factor, he mentions the long indoor feeding period.

Sex of the foal seemed to have no or only a minor influence on the growth rate at the time of maturity (MacCarthy and Mitchell, 1974; Saastamoinen, 1990).

1.1.2. Gestation length and factors affecting it

The horse is a seasonally polyestrous breeder. Meaning horses are not naturally able to breed around the year. The length of daylight is the primary contributor to the onset and cessation of the ovulatory estrous cycle in a mare. Additionally, general factors like nutrition and climate are affecting the estrous cycle (McDonald's Veterinary Endocrinology & Reproduction 5th Edition, 2003).

In a study done in Southern Finland, including in total 179 Finnhorse and Standardbred mares the most common time for the anoestrus mares to start their estrous cycle was in the middle of May (Koskinen and Katila, 1991).

In a study made in Finland by Reilas *et al.* (2014), the average gestation length was counted from a group consisting of 8952 pregnancies in 3649 different Standardbred mares used in breeding in Finland and 4579 pregnancies of 2149 different Finnhorse. The mean length of gestation of a Finnhorse mare was 334.8 days and Standardbred mare 331.7 days. In the same study, they found out that the effect of the mare's reproductive status on the length of the gestation time was statistically significant ($P>0.0001$) in both Finnhorses and Standardbreds. The gestation length in maiden, barren, or rested mares was significantly longer than in mares that had foaled on the year of insemination.

Foals born to primiparous mares are lighter until 12 months of age and smaller until 18 months of age. At birth, mares foaling for the first time were giving birth to lighter and smaller foals and placentas. Foals born to first-timer mare remained lighter than the foals of the mares that had given birth previously. This difference in the weight was seen until 360 days of age and the smaller size was visible until at least 540 days of age (Robles *et al.*, 2018).

1.1.3. Growth rates in Standardbred and Finnhorse weanlings

The coldblooded Finnhorse, the only Finnish national horse breed, and Standardbred trotters are the most common horse breeds in Finland (Suomen Hippos, 2020).

In a study by Saastamoinen (1990) with Finnhorse foals during their growth between ages 6 months and 2 years, he makes the general finding that the difference between genders was seen in size. Males were dominantly taller, longer, and wider, but females were heavier and more robust in build.

In a study by Sandgren *et al.* (1993) the average birth weight of a standardbred foal was 52.5 kg (ranging between 37 and 68 kg) and was nearly the same for the foals born in March, April, and May, but lower in foals born in June.

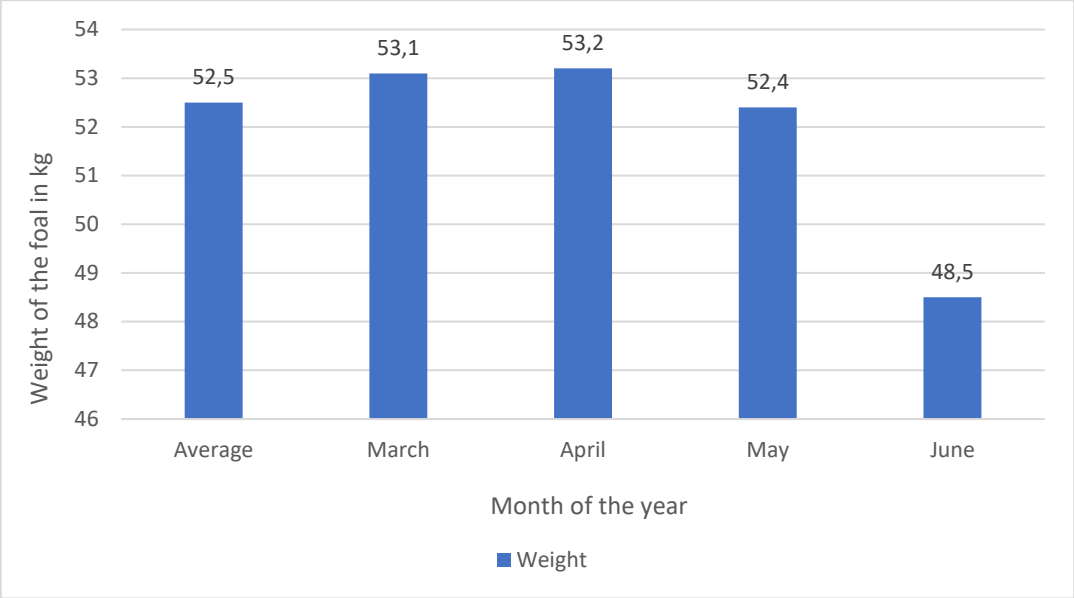

Figure 1. Birth weight of the foals in different months of the year by Sandgren *et al.* (1993).

In a study by Saastamoinen (1996) in Finland with Finnhorses, Standardbreds, and Warmblood riding horses, the average daily gain in Finnhorse foals body weight was 615 grams (+/-15,8 g) between the age of 7 and 10 months. Among Standardbreds, the average daily gain at the same age group was 512 grams (+/-31,6 g). During the next two months, at the age between 10 and 12 months the average daily gain was lower, 517 g (+/-17,2 g) in Finnhorses and 470 g (+/-34,4 g) in Standardbreds.

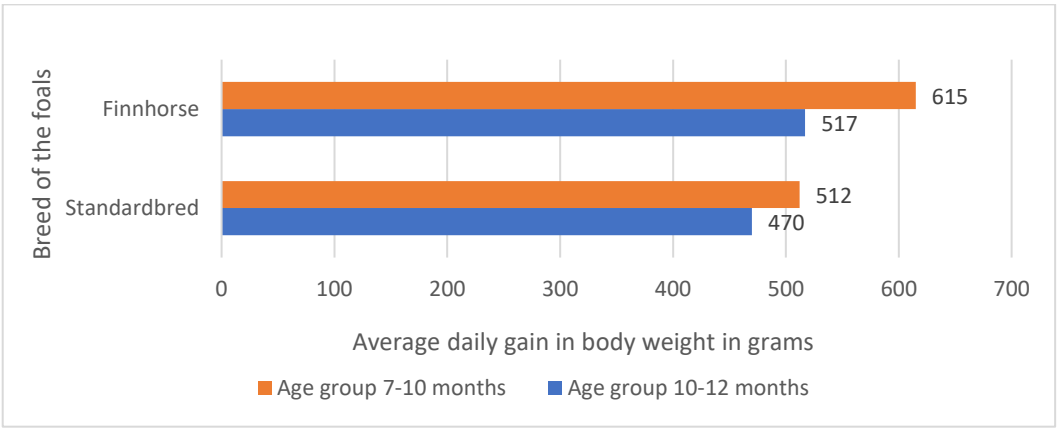

Figure 2. Average daily gain of body weight in two different age groups of Finnhorse and Standardbred foals by Saastamoinen (1996).

While studying the energy intake of weanling horses in cold loose housing system in Finland with Standardbreds and Finnhorses Autio *et al.* (2008) did find out that the median body weight of these horses was 262 kg at the age of six months. At the end of the study period, at the age of 10 months, the weight median was 340 kg.

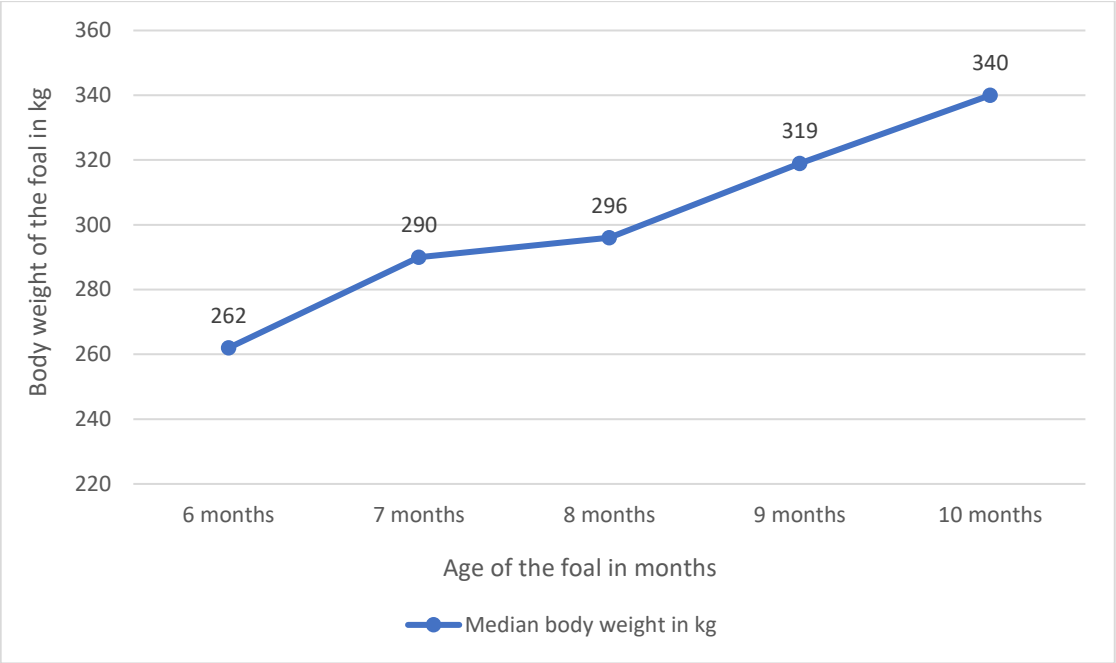

Figure 3. Median body weight of the foals at ages from six to ten months by Autio *et al.* (2008).

In the same study, the median average daily gain was 610 g during the whole study period between the ages of six and ten months. Median average daily gain decreased during the study period being 820 g at the age of six months, 710 g at the age of seven months, 640 g at the age of eight months, 380 g at the age of nine months.

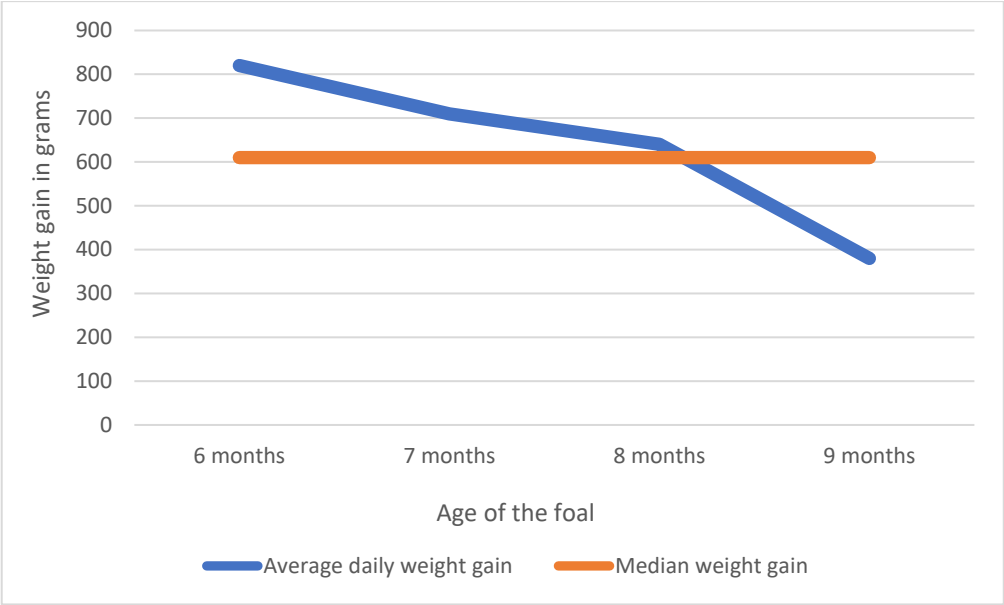

Figure 4. Average daily weight gain of foals in ages between six and nine months by Autio *et al.* (2008).

1.1.4. Fast early development

It has been shown that the earlier the breaking and training of the foals start, the better their racing performance can be. In a Finnish study by Saastamoinen (1991) three-year-old Standardbred trotters in Finland broken at the age of 1 or 1,5 years were 2.1 seconds faster ($p < 0{,}01$) and had more starts during whole their racing career ($p < 0.05$) than their racemates broken at later age. In this study, the main reasons for both Finnhorses and Standardbred horses not starting a racing career at all or for poorer racing performance than expected were injuries and diseases, the bad character of the animal, lack of talent, and poor training.

The class of persons responsible for breaking and training played a minor role in foal's later racing performance. However, those trotter foals that had been broken and trained by professional trainers seemed to have better racing results in their racing career compared with trotters broken and trained by breeders and owners (Saastamoinen, 1991).

1.1.5. Importance of early good development to the whole racing career

The opportunity to exercise is influencing the total intensity of physical exercise in the foal's life. This exercise is responsible for the biomechanical loading of the musculoskeletal tissues and therefore the development of it. Confinement of foals in boxes inside the stable for a big part of the day is shown to inhibit the musculoskeletal development in these foals. A little addition of exercise to the confinement or continual paddock exercise resulted in tissue properties that in general aided bones to be more resistant to deformation like osteochondrosis. (Firth *et al.*, 2011).

Due to the need for an early start of breaking-in and training, these foals are objected to an increased physiological load from the training while still growing. Simultaneously foal's body energy and nutrient intake requirements are high. (Ringmark, 2014) The training that foals and adult horses are performed on is aimed to get improvements in aerobic metabolism (Ronéus *et al.*, 1992) and to gain alterations in locomotive tissues (Firth, 2006).

In racehorses, performance failure and training interruption is shown to be caused mostly by health problems (Vigre *et al.*, 2002; Hamlin and Hopkins, 2003). In a study done in Denmark 1997-1998 lameness, mainly of the carpal and fetlock joints, was the most frequent health problem among Standardbred racehorses in professional training. The second and third most frequent health problems were respiratory diseases and muscular problems. (Vigre *et al.*, 2002) In a similar study in New Zealand from 1996 to 1997, the most frequently seen problem in a similar horse group was infectious diseases. The second and third most common reasons were musculoskeletal injury and loss of athletic performance (Hamlin and Hopkins, 2003).

5.3. Loose housing of horses

The other options for housing horses besides single boxes indoors are gaining recognition. The interest in keeping horses in groups is increasing (Hartmann *et al.*, 2015) and in a study made by Mejdell *et al.* in 2020 in Nordic countries, they stated that housing horses outdoors permanently in winter is gaining popularity.

A loose housing system for horses is typically characterized by keeping horses in groups, free access to an unheated and covered sleeping area that has bedding and an outdoor paddock (Autio *et al.*, 2008; Junkkari *et al.*, 2017).

In their study 1997 Zeeb and Schnitzer tell that if horses are kept loosely in social units, they can be in motion up till 16 hours per day for feed intake. Therefore, it is necessary to find compensation for the loss of activity if horses of any age are kept in confined stable conditions. If an adequate amount and type of exercise is not provided, even in adult horses the tendons, ligaments, and joints lose their elasticity. In addition to this, the shortage of necessary exercise slows down the self-cleaning mechanism of the respiratory tract and this way might impair the airway health of the animal.

In the same study Zeeb and Schnitzer are concluding, that with a point of view to the possibilities for exercise and the stimulation for exercise, loose housing in groups combined with access to paddocks can be considered as most suitable to horses.

In a study made in Finnish loose housing stable, Autio and Heiskanen (2005) were able to establish that the foals were able to follow the natural species-specific behavior and to follow the normal circadian rhythm in the loose housing and paddock environment. These species-specific behavioral patterns for foals are resting, eating, and being active.

The loose housing stables included in the same study were able to ensure the foals access to the outdoors throughout the day. The indoor sleeping hall offered a safe place for rest and protection against the winter weather conditions that included wind and rain. In this study,

the behavior of the foals did not greatly change while the outdoor temperature changed. Based on the behavior of the foals, they concluded that the foals did not seem to suffer from the cold weather conditions during the wintertime.

In a study by Hartmann *et al.* in 2015 covering a total of 3,229 Norwegian, Swedish, Danish, and Finnish horse owners they found out that 8% of horses included to the study were at no time kept in groups, 47% were every day grouped for 24 hours a day, and 45% were stabled singly but grouped during turnout. Out of age categories, the yearlings were most often permanently kept in groups (75%). In the conclusion they propose that national horse welfare recommendations should recognize that grouping horses is the optimal way to fulfill the horses' social need for contact with other horses.

In a Norwegian study also done in 2015 by Bøe *et al.*, which included 2075 horse owners, 25 % of them reported that they kept their horse of any age permanently outdoors during all seasons of the year. In addition to Hartman *et al.* also Bøe *et al.* are suggesting that the national recommendations should take stronger into consideration the horses' biological needs to have access to outdoors and grazing. They emphasize the fact that access to pasture can be considered a basic need in all grass-eating livestock.

1.1.1. The activity of the foals in the loose housing

In a study of the development of an equine musculoskeletal system in foals up to the age of 11 months, the type and load of exercise foals get while being on pasture was superior compared to the foals living in boxes (Barneveld and Weeren, 1999).

Autio and Heiskanen did study (2005) the behavior of in total of 10 Standardbred and Finnhorse foal that was loose housed with paddock access. The studied foals spent 51.4% (+/- 5.8%) of the time in the open paddock, 43.2 % (+/- 6.6%) of the time in the sleeping hall, and 5.2 % (+/- 2.7%) in the shelter that was a roofed and partly walled area in front of

the entrance of the sleeping hall. The time when the foals were most of the time outdoors was between 08:00 and 20:00. Part of the night-time was also spent outdoors. Majority of the daytime was spent resting (32.1% +/- 2.4%), eating hay that was offered *ad libitum* (27.6 % +/- 3.0%) and standing (25.5 % +/- 2.8%). Out of all the observations 5% was used for locomotive behavior. Species-specific behavior patterns (resting, eating, being active) were followed by these foals, and in addition, they were able to follow the natural circadian rhythm of these daily activities. The decrease of ambient temperature from zero to -28C did not seem to change much the behavior of the foals. The amount of time the foals spent in the sleeping area did not increase highly, nor did the length of time spent for eating or resting. Based on their behavior of the foals, the writers also stated that the weanlings did not seem to suffer from the cold weather in the loose housing system during the winter in Finland.

Junkkari *et al.* studied 2017 the respiratory health of weaned Finnhorse and Standardbred foals in cold winter conditions and they concluded that smaller foals seem to have more challenges in loose housing facilities. Keeping weanlings in cold housing systems did not seem to have an effect on the occurrence of respiratory diseases during this time, but they emphasize the need for attention on ventilation, air quality, and feeding practices in order to provide as healthy as possible environment for the young growing foals. Their field study results suggest it might be beneficial for those Standardbred foals that are born late in the season to be kept in an indoor stable over the possibly cold Finnish winter season.

1.1.2. Importance of exercise at an early age to the joint cartilage

When horses are born, they have in their joint surface cartilage, which is similar in biomechanical properties no matter which joint is in question. When foals mature and grow, the biomechanical characteristics of the joints adapt to the functional loading demands of the exercise. This adaptation takes place very early in foals' life, reaching the level comparable to the mature horse as early as at the age of 18 months. No major adaptations take part after

this point. The fact that the adaptation of these surfaces ceases this early in life, makes the loading of joint cartilage at a young age a crucial factor (Brommer *et al.*, 2005).

Barneveld and Weeren state in their study (1999) that the fastest changes in all major constituents of the musculoskeletal system in a foal's body take place during the first five months of life. The changes are not seen only in histological, biochemical, and biomechanical components of the tissues that are known to have a good ability for remodelling and repair also in an adult animal, like bone and muscle but also in articular cartilage and tendons, that have insufficient repair capacity later in life. Since these processes continue at a decreasing rate in the age period of five to eleven months, it is a strong signal that the final compositions of tissues like collagen in articular cartilage have already been formed before this age.

This also underlines the importance of influencing the biochemical structure of lesion-prone tissues in the musculoskeletal system early in the foal's growth period. This all might help prevent joint injuries later in a racing career since it allows to create as optimal as possible biomechanical quality of joint cartilage. (Brommer *et al.*, 2005) The prevention of injuries may have massive benefits, both in economic terms and in terms of animal welfare (Barneveld and Weeren, 1999).

In the year 1999 Barneveld and Weeren made a study that included 43 foals that were known to be genetically predisposed to developing osteochondrosis. These foals were divided into 3 different groups based on exercise level: free pasture exercise, box-rest with training, and box-rest. In the foals of the box-rest group and therefore were lacking exercise, the development of the tissues musculoskeletal system was delayed. When the exercise level was increased after 5 months of box rest, most tissues had compensatory development, but total collagen and some post-translational modifications of the collagen network of the extracellular matrix of articular cartilage did not.

Barneveld and Weeren suggest in the same study that exercise is a major contributor in the determination of the final biomechanical structure and strength of articular cartilage. They see it as a possible tool for their ability to resist injury in the future.

Even brief, mild exercise by spontaneous movement can be seen beneficial in increasing resistance of bones to deformation (Firth *et al.*, 2011).

During the first month of life, the daytime workload of foals was approximately twice that of older foals in the study by Kurvers *et al.* (2006) and therefore they say it is probable that the most crucial timeframe to the influence of exercise on the development of the foal's musculoskeletal system is the first month of life.

1.1.3. Social contacts of foals in loose housing

Zeeb and Schnitzer describe in their article (1997) horses as sociable animals according to their nature. Behavioral disorders can arise if these demands of social individuals are not fulfilled. Simultaneously it is important to consider the social hierarchy, no matter if the horses are kept in groups or individual boxes in stables. The possibility for contact between different animals should be as free as possible in any type of animal housing.

In the same article, they list the type of contact that is essential if animals are individually housed. These contact types are by hearing, seeing, and smelling. It is also pointed out that horses in the wild are surviving by avoiding the predators, therefore they are vigilant, and control of the environment plays a vital role in their survival. When housed, the horses are participating a reasonable amount in the events in their habitual area. The social hierarchy plays an important role. The low-ranking horses should have a possibility to be further away from the higher-ranking horses. This can be ensured by providing partitioning walls to stables or bushes to the pasture. In this article, they suggest that young horses should be reared in groups. This is the only type of housing for horses that gives them this important developmental stimulation which encourages the normal social type of behavior and supports sufficient feed intake and exercise.

1.1.4. Injuries in the loose housing

Keeling *et al.* made a study in 2016 on 233 Swedish, Danish, Norwegian, and Finnish horses that in the majority were privately owned horses and most of them were used for leisure or they were young and untrained. These horses were divided into 61 different groups of different age and gender deviation and they conclude that variations in gender and age configuration of the animal group had small effect on the number and severity of injuries. In the study, the injuries that were recorded were only superficial and minor, not requiring medical attention. Therefore, they state that there is no support to the belief that the risk of severe injuries increases when horses are kept in groups, at least when the horses are accustomed to living in groups. In a study by Hartman *et al.* (2015) among horse owners in Nordic countries, the fear of injury in horses while housed in groups remains one of the main concerns among respondents.

In their study in 2016 Keeling *et al.* emphasize that fear of severe injuries to the foals while grouping them is likely overemphasized. Therefore, they encourage housing horses in groups of different gender and age composition.

In a study by Hartman *et al.* (2015) among Nordic horse owners 57.6% of the Finns believed that keeping horses in groups increases injury risk in horses, while 39.1% of Danish horse owners had the same mindset.

2. AIMS OF THE STUDY

The aim of this study is to monitor the growth of weanling horses in Finnish cold loose-housing stables. The measured values are height at withers, weight in kilograms, and body condition score (BCS). The parasitic burden was tested by one fecal sample.

3. MATERIALS AND METHODS

The study was carried out in Finland between November 2019 and March 2020. Participating voluntarily in the study were 8 stables from the Savo county, all of them using loose housing system for their young horses.

The study recorded the growth of 37 weanlings in cold loose-housing stables. The breeds of the foals were Finnhorse and Standardbred trotter. Horses were weighed and measured at withers from two to four times during this study. Clinical health examination was completed on all the foals once during the study period. The interval between weighing the foals was from 28 to 71 days.

During the clinical examination, the following information and measures were recorded: rectal temperature, capillary refill time, the color of the mucous membranes, heart rate, respiratory rate, lung sounds, discharge from eyes or nostrils, swelling of lymph nodes, sounds from the gastrointestinal tract, testicles, umbilicus, type of fur coat, any swelling or injuries (particularly in the legs) and type of feces. Fecal samples were collected during clinical examination when available. If the sample was not gained during the clinical examination visit, samples were later sent to a commercial laboratory by the horse owners or stable managers.

Out of the 37 samples, 20 were analyzed in the Movet laboratory in Kuopio, Finland, and 17 samples were analyzed in the parasitology laboratory of the Estonian University of Life Sciences in Tartu, Estonia.

3.1. Characteristics of the foals

In total there were 37 foals included to this study. Twelve foals were Finnhorses (nine colts, three fillies) and 25 Standardbred foal (thirteen colts, twelve fillies).

The Standardbreds in this study were all Finnish Standardbred trotters. They were both American Standardbreds and crossbreds of American Standardbreds and French Standardbred trotter. The Finnhorse is bred for several purposes: trotter, riding horse, pony, and draft horse. In the study majority of Finnhorse yearlings were of the trotter type.

3.2. Age of the foals

The foals in the study were 180 days old on average at the first examination. The variation of the age was between 108 -226 days, as shown in Table 1.

Table 1. Age in days of the weanlings at the first examination

	Total	**Finnhorses**	**Standardbreds**
Average age	180	177	182
Minimum age	108	142	108
maximum age	226	208	226

3.3. Health assessment

A written health assessment as a form of clinical examination of the foals was completed. Measurements of the heart rate, respiratory rate, and body temperature rectally were written down. Any type of ocular or nasal discharge was recorded, and lymph nodes of the head and

throat were palpated. The capillary refill time in the gingiva was recorded, as was the color of the mucous membranes. The sounds from the lungs and gastrointestinal tract were analyzed with the help of a stethoscope. Fecal samples were collected when available and analyzed for parasitic eggs. Legs were checked for any swelling or wounds. Umbilicus was checked for any abnormalities and the type of fur coat was visually analyzed. Type of feces was recorded for diarrhea.

A foal was considered sick if rectal body temperature was 38.5°C or higher, or if rectal body temperature was above 38.3°C and simultaneously one or more clinical symptoms were found, e.g.: enlarged lymph nodes or discharge in the nostrils. The owners were also interviewed during all other measuring visits.

3.4. Body condition score

Several body condition score (BCS) gradings are used. In this study, the BCS was evaluated on a scale of 1-5 (described below). This scale matches the Henneke *et al.* (1983) scale of 1-9 which is a numerical scale used to evaluate the amount of fat on an animal's body. It is a standardized system that can be used on all horse breeds without specialized tools; the condition of the animal is assessed visually and by palpation. The ideal score for body condition for weanlings in the score used is 3-3,5. For scoring the animals the neck and withers, backbone and flanks, shoulders, and ribs were palpated and evaluated.

BCS scoring system by Henneke *et al.* (1983):

1 Poor: no fat can be felt;
1.5 Very thin: fat slightly covering the spine, points of buttock prominent;
2 thin: slight fat cover over the spine and ribs. Vertebrae can't be visually identified, ribs can be visually identified, thin neck;

2.5 Moderately thin: fat covering slightly the spine and ribs. Vertebrae can't be visually identified, ribs visually identifying, points of the hip aren't visually detected;

3 Moderate: back is flat, not fatty or ridge. Vertebrae can't be visually identified, ribs aren't visually identified but easily palpated, points of the hip aren't visually detected:

3.5 Moderately fleshy: fat cover over the withers, neck, back, and ribs, ribs can be felt;

4 Fleshy: fat layer on neck, shoulders, back, withers and between ribs, ribs can be felt;

4.5 Fat: Difficult to feel the ribs, fatty back, shoulders, and neck;

5 Extremely fat: Impossible to feel the ribs, fatty back, shoulders, and neck, round fatty body, obviously fat.

3.5. Growth

The height of the foal was measured at the highest point of the withers with a measuring stick made of aluminum, produced by Roma, purchased from Hevari Oy, Vuohkalliontie 2, 18200 Heinola, Finland.

The weight of the foals was measured with a portable scale that was assembled to the floor of each stable. The scale was a portable 3-piece weigh platform produced by Equestrian Products Ltd in Leyburn, North Yorkshire, The United Kingdom.

Figure 5. A Finnhorse foal on the scale during weight measurement.

3.6. Fecal egg count

Fecal samples were analyzed for parasitic eggs. The parasites of interest were small and large strongylida (*Strongylus* spp) and *Parascaris equorum*. The analysis was done with the McMaster method.

Foals with 250 or more eggs per gram of feces (EPG) were considered to need deworming medication.

4. RESULTS

4.1. Health assessments

In the study was included total of 37 foals. The percentage of clinically sick foals during the clinical examination visits was 35,1% (n = 13). From all Standardbred foals (n = 25) the number of sick animals was nine that makes 36% and from all Finnhorse foals (n = 12) there were four foals (33,3%) that were deemed sick at the time of clinical examinations.

According to the reports from the owners, during the whole four-month study period four more foals were reported to have health issues. Two of them were Finnhorses and two were Standardbred. One owner reported that one of these Finnhorse foals needed hospital care in the end part of the study period due to severe diarrhea.

4.2. Fecal egg count

From the 37 foals in this study fecal sample was obtained from 34 foals. Out of these 34 foals, four had EPG (eggs per gram of feces) values above 250. Two of them were Standardbred and two were Finnhorses. The fecal egg count values are presented in the table below. The highest EPG value was 1481 for *Strongylus* spp and 1159 for *Parascaris equorum.*

In total, some eggs were found in the feces of 17 foals, and four of them had both types of eggs in their feces. From the rest of the foals with parasitic eggs, nine had *Strongylus* spp eggs and four *Parascaris equorum* eggs.

Table 2. Fecal egg counts by foal breed and parasite egg type. Results requiring deworming are given in bold.

		***Strongylus* spp EPG**	***Parascaris equorum* EPG**
Foal 1	Finnhorse	78	0
Foal 2	Finnhorse	0	0
Foal 3	Standardbred	109	0
Foal 4	Standardbred	20	0
Foal 5	Standardbred	0	0
Foal 6	Standardbred	126	0
Foal 7	Finnhorse	20	190
Foal 8	Finnhorse	77	0
Foal 9	Finnhorse	**321**	0
Foal 10	Standardbred	202	**1159**
Foal 11	Finnhorse	**1481**	148
Foal 12	Finnhorse	0	10
Foal 13	Finnhorse	109	0
Foal 14	Finnhorse	20	0
Foal 15	Standardbred	0	0
Foal 16	Standardbred	0	0
Foal 17	Standardbred	0	0
Foal 18	Standardbred	0	0
Foal 19	Standardbred	0	0
Foal 20	Standardbred	0	0
Foal 21	Standardbred	0	100
Foal 22	Standardbred	0	50
Foal 23	Finnhorse	0	0
Foal 24	Standardbred	0	100
Foal 25	Standardbred	0	0
Foal 26	Standardbred	0	0
Foal 27	Standardbred	0	0
Foal 28	Standardbred	0	0
Foal 29	Finnhorse	0	0
Foal 30	Standardbred	0	0
Foal 31	Standardbred	0	0
Foal 32	Finnhorse	125	0
Foal 33	Standardbred	200	0
Foal 34	Standardbred	**525**	50

4.3. Body condition score (BCS)

All foals in the study were body condition scored a minimum of three times. The fourth scoring was done in addition to 22 foals. Results are presented in Table 3.

At the first measuring time seven of the Standardbred foals were thin, having BCS of 2-2,5. That makes 26,7% of the Standardbred foals. None of the Finnhorse foals were thin at that time point. At the same scoring time, one of the Standardbreds and five of the Finnhorses were fat or extremely fat, with BCS 4-4,5. Out of all the foals 64,8% (n = 24) were in the ideal target score of 3-3,5.

At the time of the second examination, the number of foals in the ideal target score was similar to the first measuring. Still, seven of the Standardbred foals were thin, having BCS of 2-2,5. One of the Finnhorse foals had at this time point the BCS of 2-2,5. Still one of the Standardbreds and now four of the Finnhorse foals were fat or extremely fat, with BCS 4-4,5.

At the time of the third measuring, the number of thin Standardbred foals had increased to eight, while none of the Finnhorses were in this category. At the same time, none of the Standardbred foals were fat. Still, four of the Finnhorse foals had BCS 4-4,5.

Twenty-two of the foals were measured for the fourth time, among them, there were 13 Standardbred foals and nine Finnhorse foals. Four of the Standardbred foals were thin and nine in the target score. From the Finnhorses, none were in the thin, six in the ideal target score, and the rest three in the category of fat.

No foal was categorized to BCS 2 or below, meaning poor or very thin condition at any examination time point.

Table 3. Numbers of foals in different body condition scores (BCS) according to the breed at four examination times.

BCS	SB E^1	FH E^1	SB E^2	FH E^2	SB E^3	FH E^3	SB E^4	FH E^4
2 - 2,5	7	0	7	1	8	0	4	0
3 - 3,5	17	7	17	7	17	8	9	6
4 - 4,5	1	5	1	4	0	4		3
Total number of foals	25	12	25	12	25	12	13	9
%	26,9	-	26,9	9,0	30,7	-	15,3	18,1

E^1 first examination; E^2 second examination; E^3 third examination; E^4 fourth examination; % the proportion of thin to moderately thin (BCS 2-2,5) foals in the group (%)

4.4. Weight

On average the foals of the Finnhorse breed were weighting at the beginning of the study period 271,8 kg and 333,5 kg at the end of the study period as seen on Table 4. During the first examination, the fillies were on average 11,8 kg heavier than colts, but the situation was the opposite during the three later measurement time points. During the final weighing, colts were on average 6,4 kg heavier than the fillies of the same age.

Table 4. The mean weight of Finnhorse foals during four measuring time points.

Finnhorse foals	Mean weight in kg $\pm SD$	Colts	Fillies
1st examination	271,8 ±28,9	268,4 ±29,4	280,2 ±25,0
2nd examination	289,9 ±29,8	290,1 ±30,8	289,3 ±26,7
3rd examination	301,0 ±30,4	300, 4 ± 32,0	302,7 ±25,0
4th examination	333,5 ±38,4	335,4 ±39,8	329,0 ±34,7

In general, the Standardbred weanlings were smaller than Finnhorses in the first examination, the mean weight was 234,7 kg while in the last examination it was 295,7 kg (Table 5). Fillies were on average a bit lighter than colts in both breeds in the last weighing. At the final weighing, the Finnhorse foals were on average 37,8 kg heavier than Standardbred foals.

Table 5. The mean weight of Standardbred foals during four measuring time points.

Standardbred foals	**Mean weight in kg $\pm SD$**	**Colts**	**Fillies**
1st examination	234,7 ±38,2	236,3 ±44,3	232,9 ±30,2
2nd examination	258, 4 ±40,6	263,6 ±46,3	252,7 ±32,5
3rd examination	272, 0 ± 39,7	278, 1 ±46,7	265, 3 ±29,1
4th examination	295,7 ±51,4	305,8 ±52,5	271,6 ±39,2

4.5. Daily weight gain

The average daily weight gain was at highest during the growth period between the first and second measurements. In Finnhorses, the daily weight gain was in the beginning 1,40 kg and in Standardbreds, the daily weight gain was at the same time point 1,23 kg. The gain descended along the study period being 1,13 kg in the Finnhorses and 1,01 kg in the Standardbreds at the final measurement.

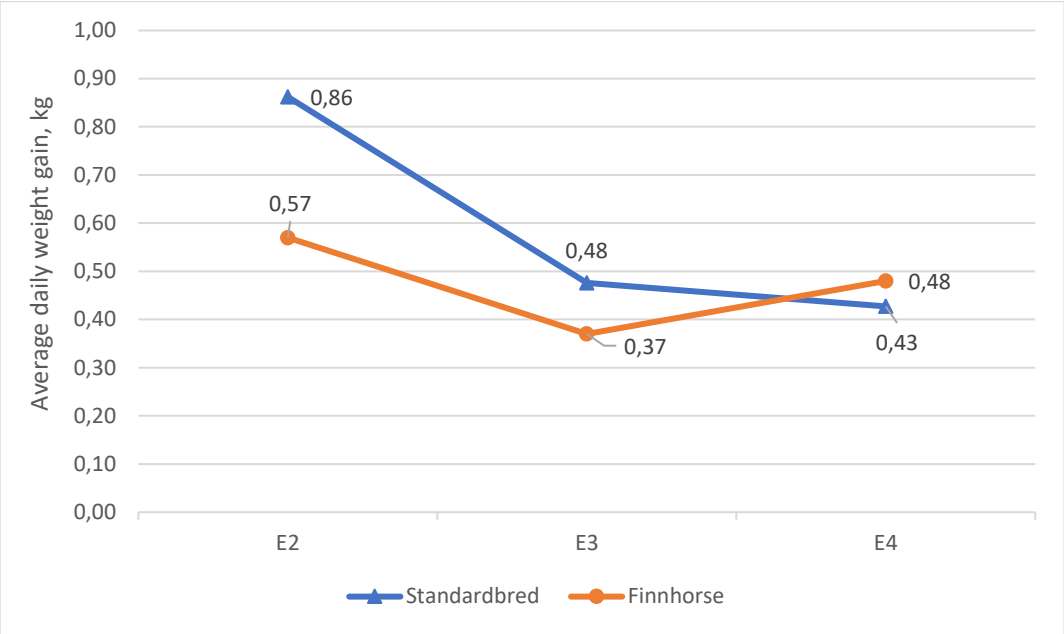

Figure 6. Average daily weight gain in kilograms in the foals during the time frame between second and fourth examination. E2 second examination; E3 third examination; E4 fourth examination

4.6. Height at the withers

Height at the withers was measured twice during this study period. It was on the first and third examination and weighting visit.

The mean height at withers in a Finnhorse foal during the first examination was 130,8 cm, while the mares being 4,2 cm bigger than colts. During the second height measurement at the third examination visit, the difference was increased to 6,7 cm. The results are shown in Table 6.

Table 6. The mean height at withers of Finnhorse foals

Finnhorse foals	**Mean height at withers, cm $\pm SD$**	**Colts**	**Fillies**
Growth, cm	4,9	4,2	6,7
1st examination, cm	130,8 $\pm SD$3,8	129,8 $\pm SD$3,3	134, 0 $\pm$ SD3,6
3rd examination, cm	135,7 $\pm SD$4,1	134,0 $\pm SD$3,0	140,7 $\pm SD$2,6

During the first examination, the mean height at the withers for a Standardbred foal was 131,2 cm, being 0,4 cm bigger than Finnhorse foals at the same timepoint. In Standardbreds, the colts were bigger at both measurement times, being 1,5 cm during the first measurement time point and 2 cm at the second measurement. The mean measurements for Standardbred foals can be seen in Table 7.

Table 7. The mean height at withers of Standardbred foals

Standardbred foals	**Mean height at withers, cm $\pm SD$**	**Colts**	**Fillies**
Growth, cm	5,0	5,2	4,7
1st examination, cm	131, 2 $\pm$ SD5,0	131,9 $\pm SD$5,6	130, 4 $\pm$ SD4,0
3rd examination, cm	136,2 $\pm SD$5,8	137, 1 $\pm$ SD7,3	135,1 $\pm SD$2,9

5. DISCUSSION

5.1. Weight and body condition score BCS

It can be said that when estimating the energy status of the foals the result from the body condition scoring is adequate. Ideally the scoring is done by the same person so differences in the scoring result based on the personal view and opinion can be eliminated. A skinny foal has generally been using fatty energy deposits to the maintenance and growth. From this can be determined that the feeding has not provided the foals adequate energy to maintain the necessary energy and fat storages.

At the first measuring times about a quarter of the Standardbred foals were thin, while none of the Finnhorse foals were scored thin. The situation among Standardbred foals was not any better a month later since the number of the thin foals was the same. The situation has deteriorated by the third measurement time since then the percentage of thin Standardbred foals had increased to a third of the whole population. The cold loose-housing environment increases the foal's energy needs in the early winter when the foals have not yet acclimatized to the cold climate in Finland (Autio and Heiskanen, 2005; Autio *et al.*, 2008). This is exactly the time point the measurements for this study were done.

The high amount of thin Standardbred foals compared to only a few thin Finnhorse foals suggests that Finnhorses as a coldblood breed is more suitable for loose housing during cold Finnish winters. The Finnhorse foals had better BCS at the beginning of the study suggesting that they also had been able to gain more energy deposits during the first summer and therefore they were able to cope with the cold better. Even though if they lost some fat deposits during the coldest weather period, it did not make them fall into the category of thin foals.

The BCS is also easy to determine by the horse owners themselves, so it would be beneficial to advise them to score their horses regularly to follow their development. Yet none of the stable owners was reporting to do it on a regular basis by manual palpation and inspection, they seemed to trust just to the visual daily inspection of the foals, mainly during the feeding time. During the winter foals grow a thick winter coat, especially when kept in cold loose housing where exposure to the coldness is around the clock. Therefore, relying on the visual inspection without any palpation cannot be deemed to be enough to gain a satisfactory and reliable amount of information on the welfare and energy status of the foals.

Skinny foals are not able to use the energy from the feeding optimally to the growth and this generates challenges later in the development to the general health for example by slowing immune system function.

The growth and development of the musculoskeletal system is important to the future start of the training and racing career, so adequate and optimally balanced feeding especially during the first winter is uttermost important. This is the time point when foals have stress from the weaning and the cold weather so the additional stress from lack of energy interferes greatly with the health and development of the foal. This can have a severe influence on the future racing career in many years to come. This seems to be largely underestimated by the horse owners. They tend to think that if the foal gains the weight later, no problems have been created during the thinner months of life.

From the number of sick foals in this study can be determined that winter in the cold loose housing system is a great challenge to the health of the young foals. Around one-third of the foals were having health problems during this four-month study period. The majority of these were flu-like symptoms (fever, coughing, and nasal discharge), only one had a kick wound and one had severe diarrhea. The owners were interviewed for the health status of the foals between the measuring times and some of them seemed to think that some nasal discharge was “normal” for a foal in cold loose housing. Due to this fact, their reports of the health history other than recorded by the study maker during the visit cannot be fully trusted.

The early winter is also the timeframe when the biggest daily weight gain is expected to take place. If a foal cannot have enough energy from feeding at this time, it is left greatly behind

by its peers. The daily weight gain slowed down in general about 20% during the study period.

Even though loose housing possibly does give challenges to the growth of the foals, feeding them, health, and handling difficulties, it has several benefits in the aspect of animal welfare. This is the housing type that provides the animals a more natural environment to live and grow by allowing free movement, around-the-clock social contacts, and *ad libitum* feeding. When done with the best practical solutions by dedicated people it could be the environment that is the optimal option for young horses.

5.4. Fecal egg count

Young foals are more vulnerable to internal parasite infection and damage than adults since they have lower immunity. Young animals are also more susceptible to damage caused by intestinal parasites due to their smaller body size. Immature lungs and digestive systems of the foals are easily damaged by migrating worms, and a parasite burden that may not cause any problems in an adult horse can easily damage or even block a foal's gut.

With a problematic drug resistance situation in the world today, it is not recommended to treat animals unless they need it, or this will compromise the ability to control worms in the future. Doing egg count tests for *Strongylus* spp and *Parascaris equorum* is critical, this is the only way to know if deworming is necessary and if it is, is it working the way we want to.

In this study, none of the foals had had fecal egg count before the one done by the study maker. All the foals had been treated with deworming medications at least once before the fecal egg count. Out of the 34 foals with fecal egg count study done, four had EPG value above 250. Three of these cases were *Strongylus* spp and one case with *Parascaris equorum.*

The foals with the highest egg counts had been treated previously with fenbendazole (product Axilur) and pyrantel embonate (Product Strongid P).

5.4.1. Parascaris equorum

Parascaris equorum, as a part of the Ascarids family, are the predominant parasite in foals between 4-8 months old, in the Finnish breeding system it means the late summer till the first winter. They can cause depression, respiratory disease, stunted growth, diarrhea, constipation, and potentially fatal colic.

Immature ascarid larvae migrate through the foal's liver and lungs. The migration through the lungs causes inflammation resulting in low-grade fever, nasal discharge, and cough. Persistent lung inflammation may then make the foal later more susceptible to other bacterial respiratory diseases.

Already at the age of a few months foal has all the lung tissue it is ever going to have. Because lung tissue heals by creating scar tissue, damage to these highly sensitive structures is permanent with less functional lung capacity available for the horse to utilize ever later in it’s life. Animals with lungs damaged by ascarid larval migration may have to breathe harder and faster to meet their oxygen demand as they develop and are asked to perform or race.

It is important to remember that fecal egg tests do not detect the migration of parasite larvae within the foal. Parasitic eggs are not shed at a constant rate in the feces, so for these two reasons collecting several samples during a longer period is highly more beneficial than just one sample from one pile of fecal matter. In ascarids, resistance to ivermectin and moxidectin is becoming common also in Finland. Therefore, also having a second fecal egg count done is important, so that the efficacy of the treatment can be verified. By the age of around eight months, the foals start to develop immunity to ascarids.

5.4.2. *Strongylus* spp

During the first winter, small strongyles become more of an issue to the foal's health. It takes several years for the young horse to develop some immunity to small strongyles. Good nutrition and good overall health of the breeding mare and foal also play a role in the management of parasitic burden. All of these things can have an effect. Also, too early treatment of the foals can have a negative impact. By treating foals sooner than two months of age more selection pressure is put on worms for developing drug resistance, without accomplishing much in control of the parasitic burden.

In this study, four of the foals had been dewormed already at the age of one month. They were all from the same stable.

6. CONCLUSIONS

Finnhorse foals tend to heavier than standardbred foals at the time of birth. The average daily gain continues in the following few months with this same trend. The sex of the foal does not have a major effect on the weight of the foal. By following the growth and BCS it can be said that Finnhorses are suitable for loose housing system also as a foal. The more delicate Standardbreds, especially the individuals born late in the summer, would benefit from housing them indoors in warmer conditions. The Standardbred foals in a loose housing system do have a risk to be too low in weight and this has a negative effect on the general health and development of the foal.

The early sound growth is nowadays nearly a necessity in racing horses. The faster they grow, the earlier it is possible to start the breaking of the animals. It has been shown that the earlier the breaking and training of the foals start, the better their racing performance can be. These properly behaving foals are also liked among trainers and owners due to the easiness and safe handling of them in everyday tasks. This makes loose housing a suitable housing system when used right since foals kept in there are shown to be easier to handle and develop soundly.

Loose housing as a solution for keeping young foals has many benefits. The positive effects to the behavior, musculoskeletal and respiratory system are lifelong and give on advantage in the possible sporting career. It has been shown that loose housing horses in groups presents no more risk of injury than housing them in single boxes. Therefore, this type of housing horse of any age is greatly popular in many countries, with a wide variety of weather conditions.

Since in this study the deworming history of the foals was so variable and partly also unknown, it is difficult to make strong conclusions of the possible resistance to deworming

agents in the participating stables. But it is commonly known beforehand that the situation is getting more and more difficult generally also in Finland. Therefore, better education of the stable owners is necessary, the old deworming routines from decades away need to be replaced by more modern plans that use the fecal egg count as a helpful tool.

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